

WHAT IS CLAIMED IS:

1. A system for custom-polarized photolithography illumination, comprising:
  - an illuminator operable to generate an illumination pattern of light;
  - 5 a polarizer unit operable to variably polarize the light; and
  - a mask pattern defining photolithographic pattern features in two dimensions, the mask pattern associated with a mask capable of transmitting at least a portion of the variably polarized light through the mask pattern.
- 10 2. The system of Claim 1, wherein the polarizer unit comprises one or more polarization rotators capable of:
  - receiving the light from the illuminator; and
  - rotating the polarization of a portion of the light to generate tangentially polarized light.
- 15 3. The system of Claim 2, wherein each polarization rotator is operable to vary the polarization of a different portion of the light received by the polarizer unit.
4. The system of Claim 2, wherein at least one polarization rotator  
20 comprises a half-wave plate.
5. The system of Claim 2, wherein:
  - the illumination pattern comprises a dipole illumination pattern having two symmetrically opposed light beams; and
  - 25 the polarization unit rotates the polarization of at least a portion of the illumination pattern such that the two symmetrically opposed light beams have polarizations in the same direction.

6. The system of Claim 2, wherein:

the illumination pattern comprises a quadruple illumination pattern having a first and second set of symmetrically opposed light beams; and

5 the polarization unit rotates the polarization of at least a portion of the illumination pattern such that the first set of symmetrically opposed light beams have polarizations in the same direction and the second set of symmetrically opposed light beams have polarizations in the same direction, wherein the polarizations of the first set of light beams is perpendicular to the polarizations of the second set of light beams.

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7. The system of Claim 2, wherein:

the illumination pattern comprises an annular illumination pattern having a plurality of sets of symmetrically opposed light beam portions;

15 the polarization unit rotates the polarization of at least a portion of the illumination pattern such that each light beam portion of a set of symmetrically opposed light beam portions has polarizations in the same direction, wherein each set of symmetrically opposed light beam portions has polarizations in a different direction.

8. The system of Claim 1, wherein the illuminator comprises:

20 a light source operable to generate light;  
a polarizer capable of linearly polarizing the light; and  
a prism system capable of forming the illumination pattern.

9. The system of Claim 1, further comprising:

25 a lens system operable to receive and direct the transmitted light;  
a wafer, wherein at least a portion of the wafer is covered in a photoresistive material capable of forming the photolithographic pattern on the wafer when the material is exposed to at least a portion of the variably polarized light, the pattern specific to the variable polarized light; and  
30 a medium disposed between the lens system and the wafer.

10. The system of Claim 9, wherein the medium comprises a liquid.

11. A method for custom-polarized photolithography illumination, comprising:

- generating an illumination pattern;
- varying the polarization of the light in the illumination pattern; and
- 5 transmitting the variably polarized light through a mask pattern associated with a mask and defining photolithographic pattern features in two dimensions.

12. The method of Claim 11, further comprising:  
receiving the light from the illuminator at a polarizer unit; and  
10 using a polarization rotator of the polarizer unit to rotate the polarization of the light to generate tangentially polarized light.

13. The method of Claim 12, further comprising varying the polarization of a different portion of the light using a different polarization rotator.

15 14. The method of Claim 12, wherein at least one polarization rotator comprises a half-wave plate.

20 15. The method of Claim 12, wherein the illumination pattern comprises a dipole illumination pattern having two symmetrically opposed light beams, the method further comprising rotating the polarization of at least a portion of the illumination pattern such that the two symmetrically opposed light beams have polarizations in the same direction.

25 16. The method of Claim 12, wherein the illumination pattern comprises a quadruple illumination pattern having a first and second set of symmetrically opposed light beams, the method further comprising rotating the polarization of at least a portion of the illumination pattern such that the first set of symmetrically opposed light beams have polarizations in the same direction and the second set of  
30 symmetrically opposed light beams have polarizations in the same direction, wherein the polarization direction of the first set of light beams is perpendicular to the polarization direction of the second set of light beams.

17. The method of Claim 12, wherein the illumination pattern comprises an annular illumination pattern having a plurality of sets of symmetrically opposed light beam portions, the method further comprising rotating the polarization of at least a portion of the illumination pattern such that each light beam portion of a set of  
5 symmetrically opposed light beam portions have polarizations in the same direction, wherein each set of symmetrically opposed light beam portions has a polarization in a different direction.

18. The method of Claim 11, further comprising:  
10 generating light;  
linearly polarizing the light; and  
directing the variably polarized light through a medium to expose  
photosensitive material disposed on a wafer to at least a portion of the variably  
polarized light to form a photolithographic pattern.

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19. The method of Claim 18, wherein the medium comprises a liquid.

20. A system for custom-polarized photolithography illumination, comprising:

a means for generating an illumination pattern having linearly polarized light;

a means for separating the illumination pattern into a plurality of light beams;

5 a means for varying the polarization of the light across the illumination pattern by rotating the polarization of at least a portion of the light to generate tangentially polarized light;

a means for transmitting the variably polarized light through a mask pattern associated with a mask and defining photolithographic pattern features in two  
10 dimensions;

a means for directing the variably polarized light through a medium onto at least a portion of a photoresistive material disposed on a wafer; and

a means for exposing the photosensitive material to at least a portion of the variably polarized light to form a photolithographic pattern.